INSTRUCTION MANUAL

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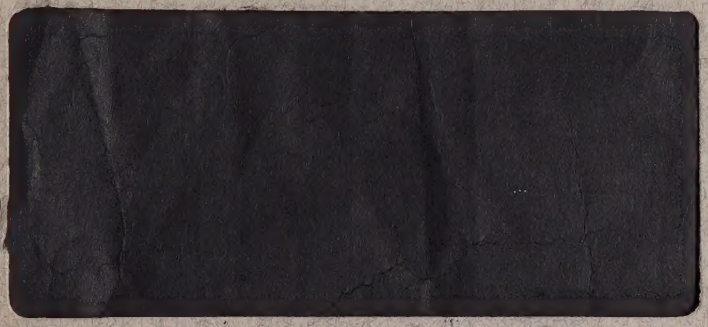

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915 PEMBROKE STREET • BRIDGEPORT 8, CONNECTICUT

PRELIMINARY INSTRUCTION MANUAL

for

PANORAMIC NARROW-BAND FREQUENCY RESPONSE PLOTTER FRP-3

T.G. LAB G. QUIRK

THE SINGER COMPANY
METRICS DIVISION
915 PEMBROKE STREET
BRIDGEPORT, CONNECTICUT

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SECTION 1

INTRODUCTION

1-1. GENERAL.

1-2. This manual contains information about the installation, operation, theory and adjustments for Panoramic Narrow-Band Frequency Response Plotter FRP-3. In addition, information is presented about the applications and characteristics of equipment supplied. Before operating the equipment, the user should become familiar with the operating instructions contained in Section 3.

1-3. APPLICATIONS.

1-4. The FRP-3 analyzes frequency sensitive elements such as high Q filters, resonant circuits, crystals, and amplifiers. Some of the methods used in analyzing these elements are as follows:

a. Provides an automatic visual presentation of frequency versus amplitude.

b. Displays characteristics of high Q filters, resonant circuits, and crystals.

c. Detects spurious responses which might be missed by the point-by-point method of analysis.

d. Compares the characteristics of an item under test with that of a given standard.

1-5. DESCRIPTION.

1-6. The FRP-3 consists of Frequency Generator G17 and Indicator I17. These units may be mounted within a common cabinet or supplied for rack mounting. Interconnecting cables provide the means for Generator and Indicator synchronization. The Generator contains controls for manual selection of the desired frequency. A response on the Indicator of the unit or circuit under test is shown on the screen of a long-persistence, flat-faced, cathode-ray tube. The CRT presentation selected may be linear, logarithmic or expanded.

1-7. EQUIPMENT SUPPLIED.

DESCRIPTION	QUANTITY
a. Generator G17	1
b. Indicator I17	1
c. Interconnecting Cable	1
d. Interconnecting Cable Coaxial	3
e. Line Cord, AC, 3-wire (with adaptor for 2-wire power line) Singer No. 556161-066	2
f. Wrenches for Socket Head Screws	3
g. Tool Alignment Walso No. 2543	1
h. Spare Fuse	1

1-8. ELECTRICAL CHARACTERISTICS.

1-9. Table 1-1 lists the electrical characteristics for the FRP-3.

Table 1-1. Electrical Characteristics

Characteristic	Specification
Frequency Range	10 kilocycles to 15 megacycles
Sweepwidth	0 to 100 kilocycles
Generator Amplitude	1 volt at 10 kilocycles to .2 volt at 15 megacycles
Generator Attenuation	0 db to 75 db in 5 db steps
Indicator Amplitude Response	70 microvolts to 300 microvolts
Indicator Attenuation	100 db in 1 db steps and a 20 db if attenuator. A 20 db non-calibrated variable 20 db control is also available.

Table 1-1. Electrical Characteristics (cont.)

Characteristic	Specification
Relative Voltage Accuracy	± 15 percent for all frequencies on LIN amplitude scale. ±1 db for all frequencies on LOG amplitude scale. ±.1 db for all frequencies on EXP scale.
Resolution	Figure 1-1 is a nomograph which illustrates the relationship between sweep width, resolution, and sweep rate. The nomograph can be used to determine the best possible resolution for any given combination of sweep width and sweep rate. The figures given in the nomograph apply only within the limits specified in this table.
Sweep time	Variable from .4 seconds to 40 seconds or manual scan control.
Generator output impedance	75 ohms
Indicator input impedance	75 ohms
1-10. PHYSICAL CHARACTERISTICS	
Generator weight	50 pounds
Depth with handles	20 inches
Width	19 inches
Height	8-3/4 inches
Indicator weight	50 pounds
Depth	18-1/4 inches
Width	19 inches
Height	8-3/4 inches
Connecting Cable Lengths	Approximately 20 inches
Cabinet Height	24 inches
Width	19-3/8 inches
Depth	20-7/8 inches

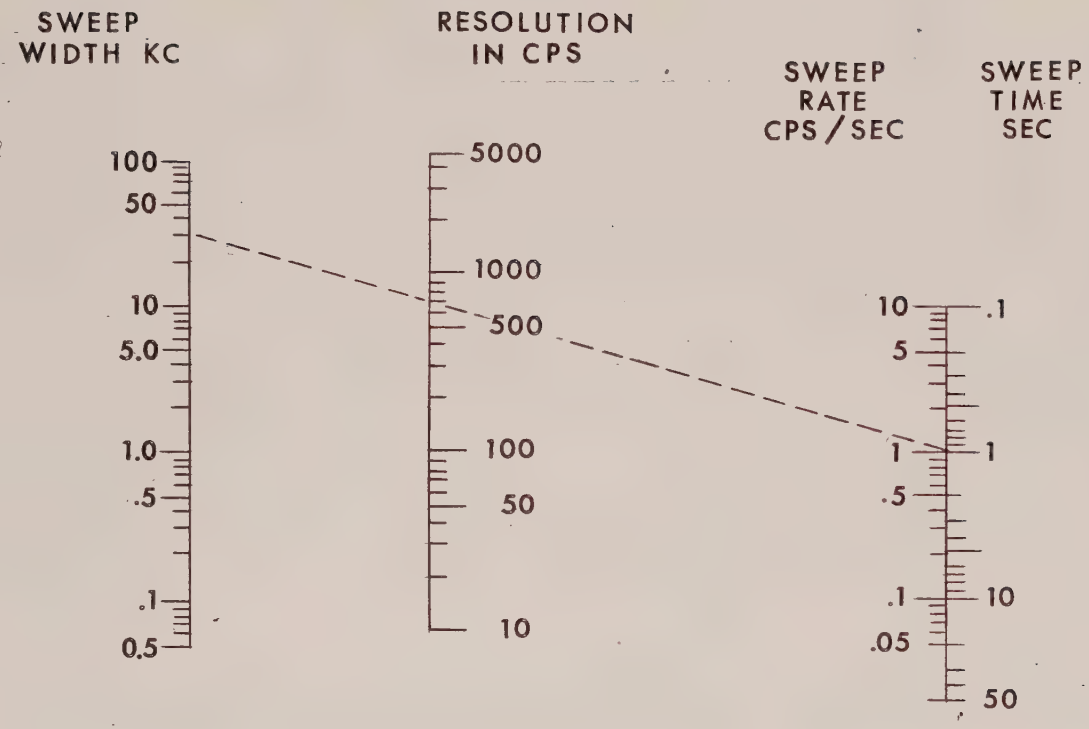

Figure 1-1. Resolution Nomograph

1-11. TUBE COMPLEMENT.

a. GENERATOR UNIT G17.

Reference Symbol	Tube Type	Function
V1	6922	Totem pole output
V2	6688	Wideband amplifier
V3	6688	Wideband amplifier
V4	6688	Cathode follower
V5	6BE6	Mixer
V6	6AK5	Buffer amplifier
V7	12AT7	Oscillator and amplifier
V8	6AH6	Reactance control
V9	6BE6	Mixer
V10	6688	IF amplifier
V11	6J6	Limiter
V12	6688	Cathode follower
V13	6688	Cathode follower
V14	6AK5	32 MC crystal oscillator
V15	OG3/85A2	Power supply reference
V16	12AX7	Power supply amplifier
V17	12AX7	Power supply amplifier
V18	6146	Power supply pass tube
V19	6146	Power supply pass tube
V20	6AH6	Crystal oscillator tube
V21	6922	Cathode follower
V22	6AK5	33.5 MC crystal oscillator

a. GENERATOR UNIT G17 (cont.)

Reference Symbol	Tube Type	Function
V23	6BE6	Mixer
V24	6688	Amplifier
V25	6688	Cathode follower
V26	6AK5	Buffer amplifier

b. INDICATOR UNIT I17.

Reference Symbol	Tube Type	Function
V101	6CA7	Series regulator (B+ supply)
V102	12AX7	Regulator control tube (B+ supply)
V103	OG3/85A2	Voltage reference (B+ supply)
V104	12AX7	Regulator control tube (B+ supply)
V105	OG3/85A2	Voltage regulator (-87 V supply)
V201	12AU7	(A) Horizontal amplifier (B) Horizontal phase inverter amplifier
V202	12AT7	Sweep generator trigger stage
V203	5ADP7	Cathode ray indicator tube
V401	6U8	(A) H.V. control amplifier (B) H.V. control tube
V402	5642	Positive H.V. rectifier
V403	1X2A	Negative H.V. rectifier
V404	6AQ5	R.F. H.V. oscillator
V501	6AN8	(A) 1st IF amplifier (B) Cathode follower

b. INDICATOR UNIT I17 (cont.)

Reference Symbol	Tube Type	Function
V502	12AY7	(A) Amplifier (B) Phase splitter
V503	5879	Balanced modulator
V504	5879	Balanced modulator
V601	5963	Switcher, flip-flop
V602	12BH7	Relay driver tube
V701	6AU6	2nd IF amplifier
V702	12AT7	(A) Crystal driver (B) Bandwidth control tube
V703	12AX7	(A) Bandwidth control tube (B) Bandwidth control tube
V704	6AU6	Isolation amplifier
V705	12AT7	(A) Crystal driver (B) Bandwidth control tube
V706	6CB6	Isolation amplifier
V707	6AU6	Final IF amplifier
V801	12AU7	(A) Vertical amplifier (B) Vertical phase inverter amplifier
V901	12AX7	(A) Sweep generator output (B) Sweep generator integrator

SECTION 2

INSTALLATION

2-1. UNPACKING AND INSPECTION.

2-2. This instrument has been tested and calibrated before shipment. Only minor preparations are required to put the instrument in operation. Check the contents against the "equipment supplied" list (paragraph 1-5) to avoid loss of parts in the packing material. The equipment is shipped with tubes and crystals installed. Make certain the tubes, crystals, and plug-in components are well seated.

2-3. MOUNTING.

2-4. The equipment is designed for cabinet mounting or for mounting in a standard 19-inch equipment rack. Slots are provided on the sides of the front panels for mounting the equipment to the front of the rack. The unit should be located in an area where the ambient light is not excessively bright, and where sufficient ventilation is available.

2-5. INTERCONNECTING PROCEDURE.

2-6. Open the rear access panel and make cable connections between the Generator and Indicator as follows:

Connector Type	From	To	Connector Type
UG-260B/U	Generator J1 OSC 1 OUT jack	Indicator J7 OSC 1 IN jack	UG-260B/U
UG-260B/U	Generator J3 OSC 2 OUT jack	Indicator J8 OSC 2 IN jack	UG-260B/U
UG-260B/U	Generator J4 SWEEP IN jack	Indicator J9 SWEEP OUT jack	UG-260B/U
Amphenol Type 4-57	Generator J15 jack	Indicator J201 ACCESS EQUIP jack	Amphenol Type 18-1P
	Generator 3 contact power receptacle	Connect to 110-125 volt 60 cps AC power source	
	Indicator J101, 3 contact power receptacle	Connect 110-125 volt 60 cps AC power source	

CAUTION

Make certain the Generator and Indicator are connected to the correct power and frequency source. If the power source does not accommodate the three wire cords (center pin grounded), then the supplied adapters should be used. When the adapters are used, connect the adapter ground wire to a suitable external ground.

2-7. INSTALLATION ADJUSTMENTS AND CHECKS.

2-8. Perform the following adjustments and checks on the FRR-3 upon installation. Should any of the adjustments fail to give the indicated results, refer to Section 5 for the appropriate maintenance action.

a. Set the G17 front panel controls as follows:

Control	Setting
BAND SELECTOR Mc/S	10
INTERPOLATION Kc/S control	0 kilocycles
VERNIER control	0
SWEEP WIDTH	50 kilocycles
OUTPUT ATTENUATOR DB	Set 40 db switch to the down position.
toggle switches	Set 5/10/20 db switches to the up position.

b. Set the I17 front panel controls as follows:

Control	Setting
MANUAL SCAN control	Mid-scale
CONTINUOUS control	Mid-scale
SWEEP TIME SECONDS STEP control	10
INTENSITY control	Mid-scale

b. I17 front panel controls (cont.)

Control	Setting
VIDEO FILTER control	OUT
AMPLITUDE SCALE selector switch	LOG
IF ATTEN DB toggle switch	Up position
INPUT ATTEN CONT control	Zero position
SIG SWITCHING	Off position
IF BANDWIDTH control	Maximum clockwise
INPUT ATTENUATOR DB	Set 20 db toggle to the down position.
Toggle switches	Set other INPUT ATTENUATOR DB toggle switches to the up position.
G BAL and R BAL concentric controls	Mid-scale

c. Allow 1/2 hour warm-up time. Turn the SCALE ILLUM control fully clockwise. The CRT screen edge lighting should go on immediately. Within 30 seconds a dot should appear on the screen and then begin to sweep across the screen. If nothing appears on the CRT screen, turn the SCALE ILLUM control fully counterclockwise PWR OFF and refer to Section 5 for corrective measures to be taken.

d. The CRT baseline trace and the baseline of the calibrated screen should coincide. Adjust the VERT control for maximum coincidence of these 2 lines. If the CRT baseline and calibrated screen baseline are not in the same horizontal line after adjusting the VERT control then the CRT should be rotated as follows:

WARNING

Make certain the high voltage leads for the CRT are not touched during this adjustment. Voltages exist at these points which are highly dangerous.

1. Loosen 1 of the 2 screws holding the CRT socket clamp.

2. Rotate the CRT tube until the CRT baseline and the calibrated screen baseline are parallel.

3. Adjust the front panel VERT control for exact coincidence of these two lines.

4. Tighten the CRT socket clamp screw.

e. To check for the correct operation of the sweep rate and associated circuitry, proceed as follows:

1. Adjust the indicator INTENSITY and FOCUS controls for a clear, sharp trace on the CRT. Do not use the INTENSITY control to compensate for bright room light falling on the CRT. If possible, the room light should be reduced or the CRT should be shielded from external light.

2. Connect a cable from OUTPUT 1 on the Generator to INPUT 1 on the Indicator.

3. Set the Generator POWER toggle switch to the ON position. The Generator green ON indicator should light. The trace on the Indicator CRT should rise above the baseline.

4. Turn the IF BANDWIDTH control fully clockwise.

5. Adjust the Generator FREQ TRIM control until the baseline rises to its highest vertical position. If the baseline goes off the screen, increase the Generator output attenuation or Indicator input attenuation to keep trace within upper third of scale.

6. Readjust the FREQ TRIM control on the generator until the baseline again reaches its highest position.

7. The difference between signal height at maximum bandwidth and the signal height at minimum bandwidth should be about 3 db.

8. Turn the BAND SELECTOR Mc/S control from 0 to 15 while keeping the signal on the CRT screen with the attenuator controls. The total signal variation through all positions of the BAND SELECTOR Mc/S selector switch should not exceed 15 db.

9. Turn the CONTINUOUS control through its complete range. The sweep time on the CRT screen should vary in accordance with the position of the CONTINUOUS control.

10. Set the SWEEP TIME SECONDS STEP control to the .4, 2, 10, and 40 positions. Note the change in sweep rate for each position of the switch.

11. Set the SWEEP TIME SECONDS STEP control to the MAN position. Turn the MANUAL SCAN control slowly from left to right. This action should cause the CRT spot to move horizontally from left to right.

12. Set the BAND SELECTOR Mc/S switch to the 0-5 position. Set the SWEEP WIDTH control to one hundred kilocycles. A pip should now appear in the middle of the CRT screen. Turn the IF BANDWIDTH control from a fully clockwise position to a counterclockwise position. The width of the pip should narrow as the i-f bandwidth is reduced to minimum.

13. Turn the IF BANDWIDTH control to a fully clockwise position and notice the appearance of noise on each side of the pip.

14. Turn the VIDEO FILTER control fully clockwise. The noise should now disappear.

15. Set the BAND SELECTOR Mc/S selector switch to any setting other than zero. A sweep trace should now appear on the CRT screen.

16. Set the B blanking control to a clockwise position. (Center of MANUAL SCAN control). Now the return trace should not be visible.

NOTE

If the sweep time is extremely short the rise and fall of the trace may be viewed at each end of the sweep.

17. Set the B blanking control to a counterclockwise position.

18. Set the SIG SWITCHING ON toggle switch to the ON (up) position. The signal should alternate between a zero level and a level above aero. Before input signal switching occurs, each complete trace should consist of a sweep from right to left and then, from left to right.

19. Set the SIG SWITCHING ON toggle switch to the off position (down).

20. Set the AMPLITUDE SCALE selector switch to the LOG position. Set INPUT ATTENUATOR toggle switches to the on position (down) until the CRT trace is on the zero db line of the calibrated scale.

21. Set the AMPLITUDE SCALE selector switch to the LIN position. The trace should move off the zero db line.

22. Increase the indicator attenuation (toggle switches) by 20 db. The trace should move back approximately to the zero db line.

23. Set the AMPL SCALE switch to the EXP position. A 5 db insertion may be necessary to bring the trace back to the zero db line.

SECTION 3

OPERATING INSTRUCTIONS

3-1. CONTROLS AND INDICATORS.

3-2. Table 3-1 lists the FRP-3 controls, indicators and jacks and the function of each. (See figure 3-1.)

Table 3-1. Controls and Indicators

Control	Function
GENERATOR G17	
BAND SELECTOR Mc/s Control	Selects one of 30 output frequency ranges. (Used in conjunction with INTERPOLATION control.)
INTERPOLATION KC/s Control	Selects the frequency required within the range indicated by the position of the BAND SELECTOR Mc/s control.
VERNIER control	Positions selected frequency on CRT. This uncalibrated fine adjustment represents approximately one kilocycle per complete revolution.
FREQ TRIM	Adjusts synchronism of Indicator with Generator.
ON indicator	When lit, indicates that power is applied to the Generator.
POWER toggle switch	Applies power to the Generator.
SWEEP WIDTH control	Selects generator sweep width (concentric control). When in the X1 C/S position, the SWEEP WIDTH control varies the sweep width from 0 to one kilocycle. When in the X. 1 Kc/S position, the SWEEP WIDTH control varies the sweep width from 0 to one hundred kilocycles.

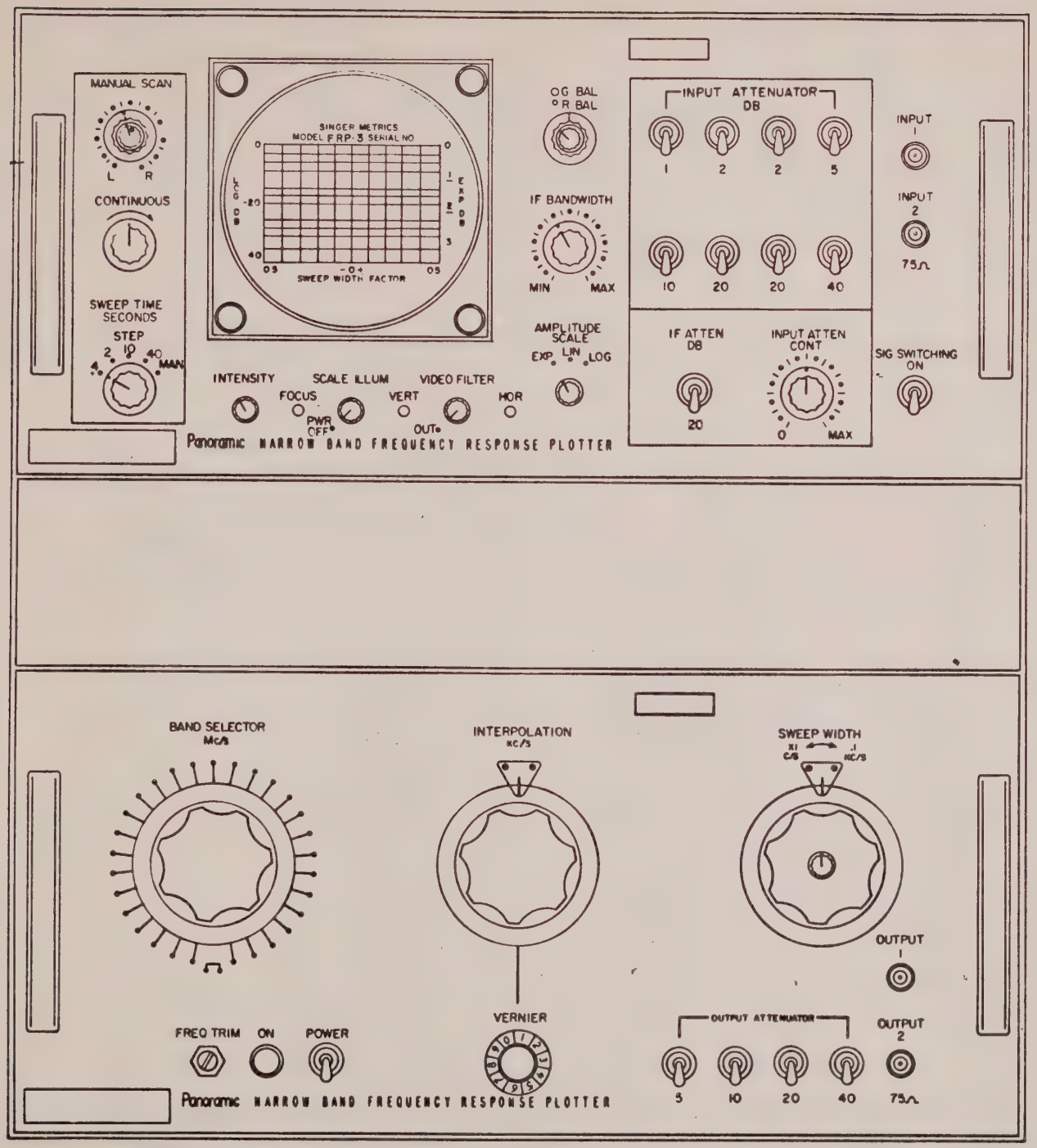

FIGURE 3-1. FRP-3 FRONT PANEL CONTROLS

Table 3-1. Controls and Indicators (cont.)

Control	Function
OUTPUT ATTENUATOR toggle switches	Attenuates the generator output level in 5, 10, 20, and 40 db additive steps.
OUTPUT 1 jack and OUTPUT 2 jack	Provide signal output connections from the Generator.

INDICATOR I17

Control	Function
SWEEP TIME SECONDS STEP control	Selects sweep time for Indicator CRT trace.
CONTINOUS	Used in conjunction with the SWEEP TIME SECONDS STEP control to select the CRT sweep time. (Uncalibrated fine control).
MANUAL SCAN & B blanking concentric control	When the SWEEP TIME SECONDS STEP control is in the MAN position the MANUAL SCAN control permits the operator to manually scan the CRT. The inner B control permits blanking of the CRT retrace sweep.
INTENSITY control	Varies intensity of CRT presentation.
FOCUS screwdriver adjust control	Varies focus of CRT presentation.
SCALE ILLUM control	Varies brightness of CRT scale indicators. Applies input power to Indicator unit.
VERT (screwdriver adjust control)	Adjusts the vertical position of the CRT baseline trace.

Table 3-1. Controls and Indicators (cont.)

Control	Function
VIDEO FILTER control	Filters unwanted video signals such as noise.
HOR (screwdriver adjust control)	Adjusts the horizontal position of the CRT baseline trace.
G BAL and R BAL (concentric control)	Suppresses internally generated deflections which could appear on the CRT screen when the frequency generated by G17 is at or near zero.
IF BANDWIDTH control	Increases or descreases the bandwidth of the Indicator i-f amplifiers from about 60 cps to 2.5 KCS.
AMPLITUDE SCALE EXP/LIN/LOG selector switch	Selects vertical presentation linearly, logarithmically, and expanded for separation of closely spaced signals.
INPUT ATTENUATOR DB toggle switches	Additively attenuate input signal entering Indicator (100 db total).
INPUT ATTEN CONT	Increases or decreases attenuation (variable, uncalibrated) of input to second mixer.
IF ATTEN DB	Produces cleaner signal by providing 20 db of attenuation in the i-f amplifier when the signal level is sufficient for this amount of attenuation
INPUT 1 and INPUT 2	Accept 2 signal inputs which are alternately displayed on the Indicator CRT.
SIG SWITCHING ON	Operates a coaxial relay in indicator & generator; this relay allows signals connected to INPUT 1 jack and INPUT 2 jack to be alternately displayed on the CRT.

3-3. OPERATING INSTRUCTIONS

3-4. Before testing a circuit perform the operating set-up procedures of table 3-2.

Table 3-2. Operating Set-Up Procedure

Control	Adjustment
GENERATOR G17	
1. POWER toggle switch	Set to down position.
2. BAND SELECTOR Mc/S	Set to frequency band desired.
3. INTERPOLATION	Turn to exact frequency desired.
4. SWEEP WIDTH X1	Set SWEEP WIDTH selector switch to X.1 KC/S
5. OUTPUT ATTENUATOR toggle switches	Set OUTPUT ATTENUATOR 5, 10, 20, and 40 toggle switches to the up position (no attenuation).
6. VERNIER control	Turn the VERNIER control to zero.
7. FREQ TRIM	Adjust FREQ TRIM control until base line rises to its highest vertical position. If base line goes off the screen, increase Generator output attenuation to keep trace within upper third of scale.
8. Connections	Connect test cable from input of item under test to OUTPUT jack on Generator G17. Connect test cable from output of item under test to INPUT 1 jack on Indicator I17.

Table 3-2. Operating Set-Up Procedure (cont.)

Control	Adjustment
INDICATOR I17	
9. SCALE ILLUM/PWR OFF control	Turn to clockwise position.
10. SWEEP TIME SECONDS STEP selector switch	Set to the .4 position.
11. CONTINUOUS control	Turn to the mid-scale position.
12. IF BANDWIDTH	Turn maximum clockwise.
13. AMPLITUDE SCALE selector switch	Set to the LOG position.
14. IF ATTEN DB toggle switch	Set to the off position (up).
15. SIG SWITCHING ON control	Set to the off position (down).
16. INPUT ATTENUATOR DB toggle switches and INPUT ATTEN CONT variable control	Set and adjust to obtain a trace within the CRT screen calibrations. At this time a presentation of amplitude versus frequency should be present on the CRT.
G17 and I17	
Control	Adjustment
17. INTERPOLATION KC/s control	Adjust until the CRT screen presentation is centered.
18. SWEEP WIDTH control	Turn counterclockwise until required part of frequency characteristics are displayed. If the sweep width becomes less than one kilocycle, set the SWEEP WIDTH control to X1 C/S and readjust the SWEEP WIDTH variable control.
19. VERNIER control	Use to center response when INTERPOLATION control is too coarse.

NOTE

The input and output impedances of the FRP-3 are 75 ohms. For undistorted signal transfer and maximum power transfer between the unit under test and the FRP-3, matching input and output impedances should be used.

3-5. TYPICAL OPERATING PROCEDURE.

3-6. The FRP-3 is normally used for the following:

a. Analyzing a single frequency response.

b. Comparing a test response against a standard response

c. Used in conjunction with a counter to determine the exact frequency of a point of interest on a response.

The test set-ups for these 3 types of tests are as follows:

1. Single Frequency Response	Connect input of the item under test to OUTPUT 1 jack on Generator G17. Connect test cable from output of item under test to INPUT 1 jack on Indicator I17. Refer to table 3-2.
2. Comparison Response (circuit under test and reference standard)	Connect input of reference standard to OUTPUT 1 jack on Generator G17. Connect test cable output from the reference standard to INPUT 1 jack on Indicator I17 Connect input of circuit under test to OUTPUT 2 of Generator G17. Connect output of circuit under test to INPUT 2 jack of Generator G17. Set the SIG SWITCHING ON control to the ON position. Refer to table 3-2 for preliminary adjustments.
3. Response Measurement with Frequency Counter Attachment	Connect frequency counter to the BNC COUNTER connector on the rear panel of Generator G17. (Refer to table 3-2 for preliminary adjustments). Set the SWEEP TIME SECONDS STEP control

to the MAN position. Slowly turn the MANUAL SCAN control to the exact point of interest on the CRT presentation. The frequency counter now indicates the frequency of this point of interest.

NOTE

Once the test set-up has been arranged and the display of interest is centered on the CRT, the user is usually interested in inspecting the high pass point or the maximum attenuation point of the response. To obtain a clear response where low signals of high frequency exist, turn the IF BANDWIDTH Control counterclockwise and adjust the FREQ TRIM control for maximum response. according to paragraph 2-10e.5. Turning the VIDEO FILTER control clockwise often increases the clarity of the display.

SECTION 4

THEORY OF OPERATION

4-1. GENERAL (See figure 4-1)

4-2. The FRP-3 consists of Generator G17 and Indicator I17. The Generator produces a 10 kilocycle to 15 megacycle sweep frequency output which passes through a test unit and is then displayed on the Indicator.

4-3. GENERATOR G17

4-4. Generator G17 consists of a reactance controlled 33.55 to 34.15 megacycle oscillator, a 32 megacycle crystal oscillator, a 30 crystal band selector oscillator, a broad band amplifier, a 33.5 megacycle oscillator, three mixers and a power supply. The reactance controlled oscillator receives its input from the interpolation discriminator through an operational amplifier. The linear range of the discriminator is greater than ±50 kilocycles. Output voltage from the discriminator (representing frequency) together with a voltage corresponding to the sweep generator sweep signal are applied to the input of operational amplifier A1. An output from amplifier A1 controls a reactance tube which in turn controls the frequency of the 33.55 to 34.15 megacycle oscillator. A vernier control in amplifier A1 permits small adjustments which effect the reactance controlled oscillator. The output from the reactance controlled oscillator is combined in mixer M1 with the output of the 32 megacycle oscillator. The difference frequency is amplified, limited and applied to the interpolation discriminator. This signal loop then, contains a variable oscillator whose frequency is locked to a crystal frequency and is capable of being swept in frequency by a suitable voltage. The discriminator design plus the use of the high gain operational amplifier provides excellent stability in the reactance controlled oscillator. An output from this oscillator together with an output selected from one of the 30 crystals in the Crystal Band Selector beat together in mixer M3. The difference frequency is buffered, amplified, and then passed through a step attenuator. The step attenuator output feeds a coaxial switch whose output passes to the circuit under test.

4-5. INDICATOR I17

4-6. Indicator I17 consists of an input attenuator, a balanced mixer, an amplifier, a second balanced mixer, and a second i-f amplifier. Also included is a detector, an indicator, a sweep generator and a coaxial relay switch. A signal output from the item under test passes through one of two inputs of a coaxial relay switch, through an input attenuator to a balanced mixer. Since the Indicator is a double superheterodyne type, two local oscillator signals are supplied. The first oscillator input passes from Generator mixer M2 to Indicator Balanced Mixer M5. The output of mixer M2 is the frequency difference between the output of the crystal band selector and the 33.5 mega-

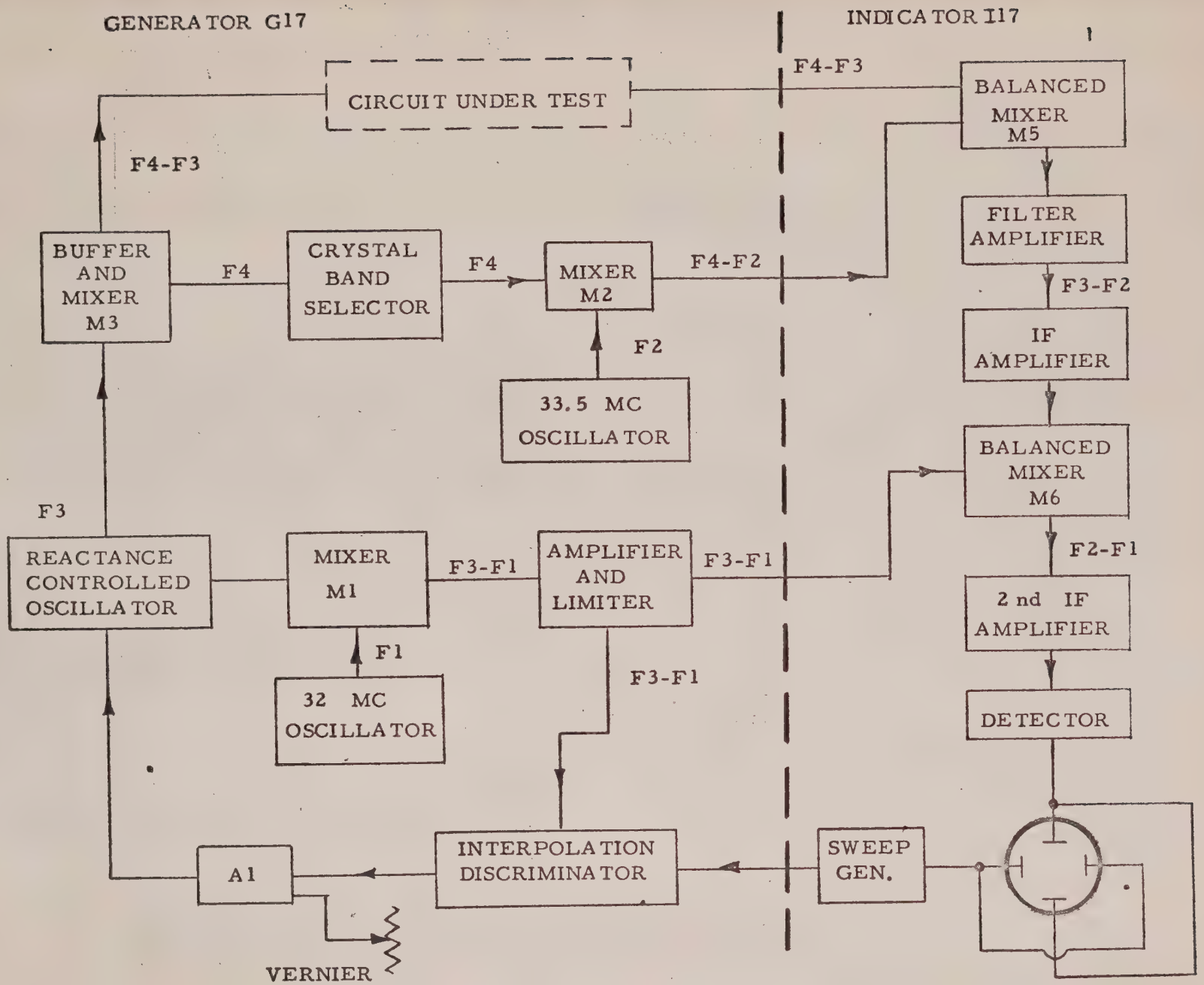

Figure 4-1. FRP-3 Block Diagram

cycle crystal oscillator. An output from mixer M5 (50 kilocycles to 650 kilocycles) is filtered, amplified, and passed to balanced mixer M6. The second Indicator local oscillator input passes from Generator mixer M1, through an amplifier and limiter to balanced mixer M6. An output from balanced mixer M6 is amplified by the 2nd i-f amplifier, detected, and then applied to the vertical deflection plates of the CRT. A sweep generator provides a triangular wave output which provides a synchronizing sweep for the Indicator CRT and the generator.

SECTION 5

SERVICE AND MAINTENANCE

5-1. GENERAL.

5-2. This section contains alignment and adjustment information for the FRP-3. This information may also be used as a guide for troubleshooting.

5-3. When an equipment trouble cannot be corrected through the use of information presented in this section, fill out the Repair and Maintenance Form included in this manual and mail it to The Singer Company. Upon receipt of this information, the service department of The Singer Company will send either further service information or instructions for shipping the instrument to the factory for repair. If it is requested, a repair cost will be estimated and submitted to the customer before servicing is begun.

5-4. TEST EQUIPMENT RECOMMENDED.

5-5. A list of test equipment to be used when servicing the unit is presented in table 5-1.

Table 5-1

Recommended Test Equipment

Quantity	Type and Model No.	Manufacturer
1	VTVM-VW Series	RCA
1	Model SG-8 Signal Generator	The Singer Company Metrics Division
1	Counter	Hewlett-Packard
1	Attenuator with minimum range of 0 to 40 db in 5 db steps	Any type
1	Attenuator with minimum range of 0 to 3 db in .25 db steps	Any type

5-6. GENERATOR AND INDICATOR ADJUSTMENTS. For the following adjustments listed in table 5-2, connect the Generator and Indicator as described in paragraph 2-8. Set the Generator PWR OFF toggle switch to the on position. Turn the Indicator SCALE ILLUM control clockwise. The order in which these adjustments are performed is not significant.

Table 5-2

Adjustments

Type of Check	Indication or Adjustment
1. Generator Power Supply Adjustment	a. Set up VTVM for a positive DC voltage reading of approximately 200 volts.
	b. Connect VTVM to TEST jack on Generator rear panel.
	c. While observing VTVM, turn ADJ (screw-driver adjust) control on Generator rear panel until VTVM reads 200 volts.
	d. If this reading cannot be obtained, measure the output voltage at the plate of V15. (Should read 85 volts). Four other tubes involved in producing the correct voltage at the TEST connection are V16, V17, V18, and V19.
2. Operational Amplifier Power Supply Check	a. Connect VTVM between pins 7 or 8 and ground on TB 1. VTVM should read +15 volts. This voltage is used for the operational amplifier.
3. Operational Amplifier Power Supply Check	a. Connect VTVM between pins 6 on TB 2. VTVM should read -15 volts. This voltage is used for the operational amplifier.
4. Generator "Frequency Locked Loop" Check	a. Obtain access to OSC TEST point, OSC ADJ, and CLAMP ADJ in Generator drawer.
	b. Set up VTVM for small negative DC voltage reading.
	c. Connect VTVM between OSC TEST point and ground.
	d. Set the Generator SWEEP WIDTH and VERNIER controls to zero.
	e. Adjust the front panel INTERPOLATION control for the VTVM reading that is closest to zero.

Table 5-2 (cont.)

Type of Check	Indication or Adjustment
	f. Turn the OSC ADJ (screwdriver adjust) for a .25 volt negative reading on the VTVM.
	g. Adjust the INTERPOLATION control for a maximum negative VTVM reading.
	h. Adjust the CLAMP ADJ (screwdriver adjustment) for a reading .25 volts more negative than that obtained with the INTERPOLATION control.
5. Generator Sweep Limit Adjustment	a. Connect a counter to the COUNTER jack at the rear panel of the Generator.
	b. Set the Indicator SWEEP TIME SECONDS STEP CONTROL to the MAN position.
	c. Set the Generator SWEEP WIDTH selector switch to the X.1Kc/S position.
	d. Turn variable SWEEP WIDTH control to the 1000 position.
	e. Turn the INTERPOLATION Kc/S control to the 250 position.
	f. Turn the VERNIER control to the 0 position.
	g. Set the BAND SELECTOR MC/S to a range within the capabilities of the counter.
	h. Using the MANUAL SCAN control, move the sweep spot to the extreme left of the CRT screen. Note the reading on the counter.
	i. With the MANUAL SCAN control move the sweep spot to the extreme right hand side of the CRT. Subtract the low counter reading from the high counter reading. If the subtraction does not fall between 97500 and 102500, adjust the Generator SWEEP LIMIT control until the CRT sweep falls within this range.

Table 5-2 (cont.)

Type of Check	Indication or Adjustment
6. Indicator Power Supply Adjustment	a. Connect VTVM, between Indicator +250 volt TEST jack and ground. (Indicator rear panel). Adjust the +250 VOLT ADJUST for a VTVM reading of +250 volts. NOTE There is considerable lag in the power supply response to this adjustment. Allow several minutes for the power supply to stabilize after this adjustment.
7. CRT HIGH VOLTAGE SUPPLY Adjustment	a. Obtain access to HV ADJUST control in Indicator. b. Prepare the voltmeter for a-1400 volt measurement and connect between J403 and ground. The meter should read between -1200 and -1400 volts. c. Slowly turn the HV ADJUST control counter-clockwise until the high voltage just begins to decrease. d. Turn the INTENSITY control through its complete range and note whether the trace maintains its vertical position for all INTENSITY settings. e. Adjust the HV ADJUST control (left rear of Indicator) for the greatest high-voltage regulation (minimum vertical shift of CRT baseline while INTENSITY control is turned through complete range). The HV ADJUST should be within 50 volts of its maximum setting.
8. CRT Sweep Alignment	a. Set SWEEP TIME SECONDS STEP control to .4. b. Adjust the HOR control (front panel) in conjunction with the CF BAL control (underneath Indicator) for a trace that extends 1/8 inch beyond each end of the graticule.

Table 5-2 (cont.)

Type of Check	Indication or Adjustment
	c. Set the SWEEP TIME SECONDS STEP control to MAN.
	d. Center the CRT trace spot with the MANUAL SCAN control. The junction of the EXT and INT line size controls (left side of Indicator) should measure zero volts if the base line is adjusted correctly.
9. Indicator IF Circuit Alignment	a. Connect a 6.3 megacycle signal from an r-f signal generator to Indicator INPUT 1.
	b. Connect a cable from Generator J1 to Indicator J7.
	c. Connect a cable from Generator J3 to Indicator J8.
	d. Connect a cable from Indicator J9 to Generator J4.
	e. Turn IF BANDWIDTH control to MIN.
	f. Set the Indicator INPUT ATTENUATOR toggle switches to the positions that produce a pip of suitable amplitude on the CRT screen.
	g. Center the pip with the INTERPOLATION KC/S control.
	h. Set the Indicator VIDEO FILTER control to the OUT position.
	i. Turn the blanking B control (within MANUAL SCAN control) clockwise.
	j. Set the SWEEP TIME SECONDS STEP control to .4.
	k. Turn the CONTINUOUS control fully counter-clockwise.
	l. Alternately adjust the tops and bottoms of Z702, Z705 and Z706 for maximum pip amplitude. Disregard the symmetry of the pip at this time.

Table 5-2 (cont.)

Type of Check	Indication or Adjustment
	m. Remove crystal Y701.
	n. Set the AMPLITUDE scale switch to EXP.
	o. Tune the top of transformer Z704 for a null.
	p. Tune the bottom of transformer Z704 for pip symmetry. If symmetry cannot be obtained, retune the top of transformer Z704.
	q. Replace crystal Y701.
	r. Remove crystal Y702.
	s. Tune the top of transformer Z703 for a null.
	t. Tune the bottom of transformer Z703 for pip symmetry. If symmetry cannot be obtained, retune the top of transformer Z703.
	u. Replace crystal Y702.
	v. Set the G17 SWEEP WIDTH control to 5 kilocycles.
	w. Turn the IF BANDWIDTH control from MAX to MIN. The center of the CRT pip should not move more than 1/2 scale division or 250 cycles per second.

REPAIR AND MAINTENANCE FORM

COMPANY _____ DATE _____

_____ ATTENTION _____

_____ PHONE _____

INSTRUMENT DATA

MODEL _____ TYPE _____

SERIAL NUMBERS: ANALYZER _____ POWER SUPPLY _____

ACCESSORIES _____ _____ _____

(IF THE FRONT PANEL SERIAL NUMBER DIFFERS FROM THE SERIAL NUMBER ON THE PATENT LABEL ON THE REAR OF THE CHASSIS, PLEASE LIST PATENT LABEL SERIAL NUMBER)

REPAIR DATA

1. TYPE OF TROUBLE* _____

_____

_____

_____

_____

_____

_____

2. TEST INSTRUMENTS USED FOR MAINTENANCE AND TROUBLE SHOOTING _____

_____

_____

_____

_____

3. APPROXIMATE DATE INSTRUMENT PLACED IN OPERATION _____

4. APPROXIMATE NUMBER OF HOURS INSTRUMENT IN OPERATION SINCE ITEM 3 _____

*Please include information on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

SINGER METRICS DIVISION

5. HAS MAINTENANCE ACTION PREVIOUSLY BEEN REQUESTED? _____

6. RESULTS? _____

7. COMMENTS:

For repair or maintenance assistance, fill out this form as completely as possible and send to:

SERVICE DEPARTMENT 540
SINGER METRICS DIVISION
THE SINGER MANUFACTURING CO.
915 PEMBROKE AVENUE
BRIDGEPORT 8, CONNECTICUT

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

MP MASTER
MA24027